



Proposed Plan for Adopting Updated Range Reference Atmospheres

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Marshall Space Flight Center
Engineering Directorate
Terrestrial and Planetary Environments Team**

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Who We Are and What We Do

The Terrestrial and Planetary Environments Team at Marshall Space Flight Center (MSFC) provides engineering analysis and subject matter expertise in the area of atmospheric environments to support:

- Aerospace vehicle design studies
- Space Shuttle day-of-launch upper air wind monitoring and verification
- Mission planning and analysis
- Engineering-level planetary atmospheric models
- Database archival and analysis



Areas of Expertise

- Upper level winds and thermodynamic profiles
 - Global Reference Atmospheric Model (GRAM)
 - Range Reference Atmospheres (1983 version)
 - Vector Wind Model
- Instrumentation
 - Automated Meteorological Profiling System
 - Sippican W-9000
- Surface weather
 - Surface winds, temperature, humidity, cloud cover
 - Lightning, precipitation climatologies
 - Atmospheric Parametric Risk Analysis (launch availability)
- Atmospheric data archiving and mining



Our Proposal

To facilitate validation, documentation and adoption of updated Range Reference Atmospheres (RRAs)

- Range Commanders Council Meteorology Group (RCC-MG) has asked MSFC to review the updated RRAs, and has proposed to publish and release documented versions.
- We would like to include the new RRAs in an update to GRAM. We need to convince ourselves that the new RRA data and computational procedures are consistent with this application.
- Proposal to be presented at May-2004 RCC-MG meeting.



Partner/Task Oriented Approach

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RCC-MG

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Proposed RRA Sites to Document

1. Cape Canaveral, FL
2. China Lake, CA
3. Edwards AFB, CA
4. Eglin AFB, FL
5. Fairbanks, AK
6. Great Falls, MT
7. Kwajalein Missile Range, Marshall Islands
8. Lihue/Kauai Island, HI
9. Mariana Island, Guam
10. Mercury-Desert Rock, NV
11. Miramar, CA
12. Point Mugu, CA
13. Saint Johns, Canada
14. Salt Lake City, UT
15. San Diego, CA
16. San Juan, Puerto Rico
17. Tucson, AZ
18. Vandenberg AFB, CA
19. Wallops Island, VA
20. White Sands Missile Range, NM
21. Wide Awake Field, Ascension Island



Task 1: Document Data Sources

- For each RRA site, define measurement platforms (answered)
 - Rawinsonde, rocketsonde, Jimsphere, etc.
- Define altitude domain (answered)
 - Example Balloon: 0-30 km Rockets: 30-70 km
- Define resolution (answered)
 - 1983: 1 km (0-30 km), 2 km above; Updates: 250 m (0-30 km), 1 km above
 - Why was resolution changed? How has this affected data quality?
- Document measurement period of record for each site
 - Have received answers, need some clarification regarding RRA workbooks
- Data quality control procedures
 - Was every profile QCd then averaged together, or were they averaged first, and QC performed only on the resulting profile?
 - For profiles with bad/missing data, is entire profile omitted?
 - Have received answers, need some clarification regarding RRA documentation
- Site applicability (answered)
 - How are data from nearby, but non co-located sites included?



Task 2: Document Analytical Models

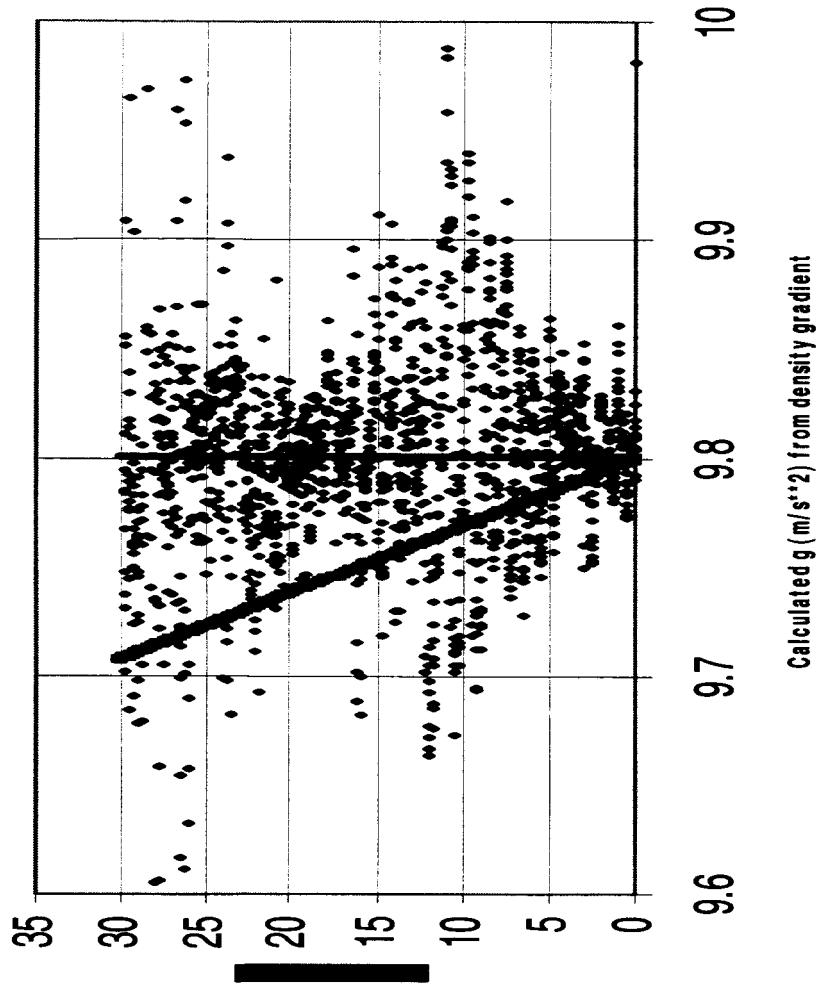
- What equations were used for calculations?
 - Have they changed from 1983 versions? If so, why?
 - Note: Equation (49) of the published 1983 versions contained a typographical error. Assurance is needed that this error has not inadvertently entered the computational process.
 - Discussions in process
- How/where in process were conversions from p to altitude done? (in process)
- How/where in process were conversions from geopotential to geometric height done? (in process)
- What was the interpolation process used in the conversion from data/computation space to the output resolution? (in process)



Task 2: Potential Issues

- How/where in process were conversions from geopotential to geometric height done?

Eglin Hydrostatic Test





Task 3: Document Computational Process

MSFC proposes to review source code to verify that analytical models are appropriately implemented.

```
SUBROUTINE PROCESS_DATA
```

```
IF (not EOF) do begin
```

```
    READ next_data_point
```

```
    CALL compute_parameters
```

```
    DO more_stuff
```

```
    i = i + 1
```

```
    PRINT "Hello World!"
```

```
ENDIF
```

```
...
```



Task 4: Compare Updates to 1983 Version

- Do both versions present the same statistical parameters?
- Compare selected values from 1983 version with updates to ensure “eye-ball” consistency.
- Document and explain differences, apply various data tests as appropriate.
 - Gas law test: variation of R with altitude
 - Hydrostatic test: variation of g with altitude and latitude
 - Geopotential height: z - H relationship with height
 - Density-temperature correlation
 - Wind shear test



Task 5: Compile Written Documentation

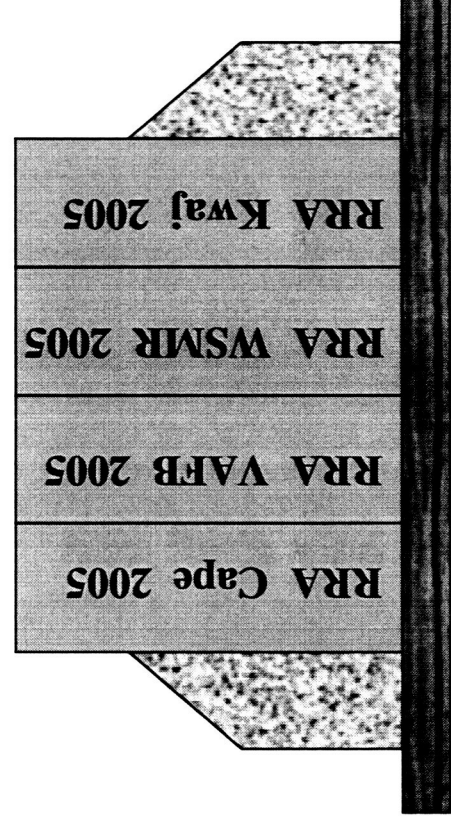
MSFC will assemble documents similar to 1983 published versions.

- Separate volume for each RRA site
- Include full documentation of production process and validation procedures
- Electronic format



Tasks 6 and 7: Approval and Publication

- Task 6:
 - Develop formal approval process in coordination with RCC-MG
 - Provide support as needed to ensure approval process is completed
- Task 7:
 - Publish new set of fully documented Range Reference Atmospheres
 - Target 2005 time frame





Proposed Tasking Details

#	Task Description	Responsible Organization
1	Document data sources	AFCCCC, input to MSFC
2	Document analytical models	AFCCCC, input to MSFC
3	Document data processing procedures	AFCCCC, input to MSFC
4	Compare updates to 1983 versions	MSFC
5	Compile written documentation	MSFC
6	Obtain approval for final volumes	RCC-MG, MSFC, AFCCCC
7	Publish new RRA datasets/documents	RCC-MG